

XXII. *Note on the Metamorphosis of Caterpillars.*

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ON that interesting part of the physiology of insects, the *metamorphosis*, an extraordinary discrepancy has hitherto existed between the statements of some of the most eminent investigators of this department of creation. I say *extraordinary*, because, for a matter capable of such easy and satisfactory elucidation as is the subject of this dispute, to have been the theme of such contradictory assertions from a considerable time back down to the present hour, as this has been, cannot but appear extraordinary. The point in difference is this:—Swammerdam, the most assiduous and expert Entomologist and one of the acutest observers that perhaps ever lived, made the discovery of a fact, which certainly deserves to be ranked among the most marvellous operations which are exhibited in nature:—*viz.* that at the same time that the moult of the external integument of the caterpillar takes place, the mucous tunic of the intestinal canal is also stripped off and rejected through the anus, and not only that, but each of the attenuated and delicate ramifications of the air vessels, invisible, or nearly so, as they are to the naked eye, sheds its internal lining, which, to the number of some hundreds, are withdrawn through the spiracles, thus leaving the animal completely renovated as it were both within and without, with increased capacity or wholly altered form. This observation was corroborated by Bonnet, a naturalist no less celebrated in this branch of science than the former. On the authority of such eminent men the fact, prodigious as it must appear, was generally received, until Herold, a very able physiologist, asserted, that *the inner skin of the intestinal canal is never cast*, and as respects the *trachea*, such moult is confined to the *large main trunks, none taking place in their smaller ramifications*. Thus a complete and irreconcilable discrepancy existed between these acute physiologists, the only difference in the nature of the observations, upon which their statements were professedly grounded, being, that Swammerdam appears to have made his on the larvæ of beetles (*Oryctes Nasicornis*, et al.), whilst Herold's appear to have been made on the caterpillars of the *Lepidoptera*. Later writers on this subject* appear to have been contented to discuss the question on the

* Kirby and Spence, Burmeister, &c.

relative merits and credibility of the before mentioned investigators, and thus the question remains at the present moment unsettled, though capable of the easiest and most conclusive ascertainment imaginable. Such being the case, I take the liberty of stating the observations which I have lately made on this subject, and which in fact drew my attention to the dispute I have just detailed. Happening to detect a caterpillar of *Sphinx Ligustri* in the act of changing its skin, I made it go through the operation in my hand, so as to watch its progress more minutely. As soon as the external integument was, after much writhing and contortion, completely slipped off, as I found it still adhered loosely to the insect, I touched it with my penknife to cause it to separate from it, when I found that it was yet connected with it in some essential manner, and, on a closer examination of the cause, I perceived at once that it was occasioned by the mucous coat of the intestinal canal, which was in the act of being gradually passed out at the anus, and being in intimate connexion with the recently shed external integument, or, according to Burmeister, *merely a prolongation thereof*, occasioned that attachment of the old skin to the caterpillar which at first had perplexed me. To this observation I may add, that I have since discovered the moulted colon in the skin of a caterpillar of the same species cast off on assuming the pupa state, lying folded up at the posterior end thereof, exactly as described by Swammerdam. As this my testimony, slightly as it might be thought of by itself, directly establishes the accuracy of such illustrious observers as Swammerdam and Bonnet, I trust it will be received as a satisfactory affirmation of the fact of *the moult of the lining of the intestine*, so unwarrantably denied by Herold. Then as to the moult of the *smaller ramifications of the trachea*, I am able to give quite as conclusive evidence of the correctness of Swammerdam's account in every particular, and consequently of Herold's inaccuracy. Quite apart from any consideration of the conflicting statements of the above naturalists, I happened to be examining the skin cast by a caterpillar of *Sphinx Ligustri* on changing into the pupa, when my attention was attracted to the very conspicuous thick whitish bands, which appear, one on each side of the body, nearly its whole length. On a close examination, I perceived that these bands were divided into a certain number of equal lengths, one end of each of which was intimately connected with a spiracle, whilst the other end was free and unattached, but from the circumstance of their all lying down in the same direction (*viz.* from the posterior end towards the anterior), and being of sufficient

length to reach from one spiracle to another, it occasioned the appearance of what I at first took for a *continuous* band as above mentioned. On reflection it at once appeared to me that these must be the *exuvia of the trachicæ*, which, as described by Swammerdam, "being collected into eighteen thicker and as it were compounded ropes, nine on each side of the body, when the skin is cast, slip gently and by degrees through the eighteen apertures in orifices of the pulmonary tubes before described, having their tops directed upwards towards the head."* To ascertain this beyond a doubt, I gently moved one of the portions of the band above mentioned about in water, when I had the satisfaction of seeing it immediately separate into those minute filaments, which proved the exact correspondence of my observation with Swammerdam's statement. It was so late in the season when my attention was drawn to this subject, that I had no opportunity of examining the moults previous to the change into the pupa, but I entertain no doubt that precisely the same operation is undergone in the former moults, and that because Swammerdam states such to be the case, whose testimony on this head has never been impugned but by Herold, whose statement I trust I have abundantly shown to be quite unfounded.

I must not omit to mention that the correctness of Swammerdam is likewise confirmed by Burmeister, inasmuch as he relates † that he had himself witnessed the facts described in the moulting of the *Libellulæ*, from all which circumstances it is apparent, that this *internal* moult, as described by Swammerdam, is universal throughout the class of insects, being thus shown to exist in the *Coleoptera* by Swammerdam, in the *Neuroptera* by Burmeister, and in the *Lepidoptera* partly by Bonnet and more fully in the present paper. How so eminent a man as Herold could fall into such an unfounded delusion as regards this matter, and in defiance too of the express declarations of such an accurate observer as Swammerdam, is a mystery. For myself, I have had no object in bringing forward the subject except to confirm the truth, careless as to whose reputation might be confirmed or affected thereby.

* *Biblia Naturæ* (Hill's Eng. Translation), vol. i. p. 135.

† Shuckard's Translation, p. 428.